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Final Report

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Shell Thickness and Hatchability in Broiler Breeders

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Shell Thickness and Hatchability in Broiler Breeders

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Abstract: The shell thickness of eggs from 25 broiler breeder flocks was determined. Because of increased numbers of thin shells, 1.5% in hatchability is being lost. The thin shelled eggs have more embryonic mortality, more bacterial contamination and lower fertility. Low pullet body weight uniformity is suggested as the cause of the thin shells. The hatcheries involved in the study are continuing to monitor the egg shell thickness and egg weights of their breeder flocks. It has been demonstrated that egg shell thickness is not just an academic concern and is affecting hatchability more than producers had previously thought.

Shell Thickness and Hatchability in Broiler Breeders

Objective

The objectives of this project were to:

1. To demonstrate that egg shell thickness affects the hatchability of eggs produced by Saskatchewan broiler breeder flocks. Research has clearly shown that shell thickness is important but it has been overlooked by commercial hatching egg producers and hatcheries.

2. To determine how the fertility, hatchability and age of embryonic death of eggs from Saskatchewan breeders compares to that found in the United States.

3. To demonstrate a practical method of measuring hatching egg shell thickness.

4. To gather data on egg shell quality that could be used to judge whether or not future breeder flocks have above or below normal egg shell thickness.

Project Design

Hatchability Monitoring (Aug.'88 - Sep.'90)

Over a one year period, the fertility, hatchability and age of embryonic mortality of 50,000 broiler breeder hatching eggs was monitored. The number of cracked, rotten and upside down eggs was also recorded. The fertility and early embryonic mortality were determined by candling all of the eggs at 6 days of incubation and breaking open the eggs which appeared clear or had a blood ring. All of the eggs unhatched after 21 days of incubation were broken open to determine the age of embryonic mortality and the number of chicks hatched was recorded. Each time that a flock was monitored, 504 eggs were checked.

Eleven hatches at Wynyard Hatchery and eight hatches at Canada Packers Hatchery were monitored, involving eggs from 14 farms and 41 flocks. Some flocks were just ending or just beginning egg production during the one year study period and were only checked once while other flocks were checked several times. During the study, hatchability was monitored once in ten flocks, twice in fifteen flocks, three times in eight flocks, four times in seven flocks and six times in one flock. No flock was checked more than once in a five week period.

Egg Shell Thickness Monitoring (Mar.'89 - Sep.'90)

The egg shell quality for the breeder flocks was determined by floating 168 day old eggs in three salt solutions to determine their specific gravity (Loeffler, 1987). The eggs floating in a salt solution with a specific gravity of 1.080 or lower were said to be thin shelled while those floating in a salt solution with specific gravity of 1.085 or higher were said to be thick shelled (McDaniel *et al.*, 1979). The thick and thin shelled eggs were marked with pencil so that the fertility, hatchability and age of embryonic death of the eggs with different shell thicknesses could be demonstrated. Differences in cracked, rotten and upside down eggs were also recorded.

Eight thousand eggs from ten farms and twenty five flocks were checked for egg shell quality. These eggs were from five hatches at Canada Packers Hatchery and six hatches at Wynyard Hatchery. Egg shell quality was measured once in twelve flocks, twice in eight flocks, three times in two flocks and four times in three flocks. Again, no flock was checked more than once in a five week period. Each time that egg shell thickness was monitored, 168 eggs were checked.

For 3,500 of the eggs, egg shell quality was classified as being either thick, thin or very thin, with the thick eggs having a specific gravity of 1.085 or higher, the thin eggs a specific gravity of 1.080 and the very thin ones a specific gravity of 1.075 or lower. These eggs were marked with pencil as being thick, thin or very thin and their subsequent hatching performance was monitored.

To determine whether or not floating eggs in a salt solution would influence their hatchability, 7,000 eggs from 17 breeder flocks and 2 hatcheries were tested. Half of the eggs from each flock were floated in three salt solutions used to determine specific gravity and the other half was left untouched. The specific gravities were done on day old eggs. The

eggs floated in salt solutions and those left alone were all layed on the same day. The fertility, hatchability, and age of embryonic death of the eggs floated and not floated in the salt solutions were compared.

Egg Weight Monitoring (Mar.'89 - Dec.'89)

A total of fifty one egg weights measurements were taken for 33 flocks from 10 farms. Eggs from each flock were weighed on one to three occasions with no flock being monitored more than once in a five week period. Approximately one hundred eggs were weighed for each measurement.
For several flocks, egg weight uniformity as well as average egg weight was determined. The egg weight uniformity was expressed as the "egg weight range". The egg weight range was determined by weighing ten groups of ten eggs, finding the average weight of each group of ten and then calculating the difference in the average weight of the heaviest and lightest groups of ten eggs. For example, if the heaviest group of eggs averaged 70.0g and the lightest 65.0g, the egg weight range would be 5.0g. A flock with a large egg weight range would have a high percentage of both very large and very small eggs. Egg weight range was measured for seven farms and fifteen flocks, with eleven of the flocks being checked once, one flock being checked twice and three flocks being checked three times. None of the flocks was checked more than once in a five week period.

Average egg weights and egg weight ranges were determined once for each of eleven flocks that were shipping eggs from Arkansas, U.S.A. to the two Saskatchewan hatcheries. Specific gravities could **not** be measured for the Arkansas flocks because the eggs were more than a day old when arriving at the hatchery.

Classification of Age of Embryonic Death and Definition of Terminology

All eggs removed at candling or unhatched after 21 days of incubation were broken open to determine the age of embryonic death. Cracked, rotten and upside down eggs were broken open to determined if they were fertile and if so, at what age the embryos had died. The cracked, rotten and upside down eggs were classified twice: once as a cracked, rotten or upside down and a second time as infertile or an embryonic death. Some previous studies, such those of J. Mauldin (1989), did not record the age of embryonic death for any eggs that were cracked, rotten or upside down.

Day 1-2: These embryos were only "small white clouds" with no signs of blood development. These losses likely occurred before or just at the time of being placed in the incubators. Day 1-2 dead embryos could only be accurately spotted when breaking open eggs during candling. Because the eggs tended to become too mixed up to spot small quantities of blood, all possible Day 1-2 dead embryos found in the unhatched eggs were classified as Day 1-3 dead embryos.

Day 1-3: This category included the Day 1-2 losses as well as any embryos which developed to the stage of forming a blood ring. These embryos likely had been weakened by improper egg storage or bacteria.

Day 1-7: These embryos included the Day 1-3 embryos as well as any that developed up to the point of having small limbs. All embryos dying in the first seven days of incubation are referred to as "early embryonic deaths" and are often considered indicators of poor egg storage conditions.

Day 8-14: These embryos had developed limbs but were not well feathered and did not have hardened beaks at the time that they died. A large number of embryos dying at this stage would have indicated a nutritional or bacterial problem.

Day 15-21: These embryos were well feathered and had hardened beaks but had not yet pipped through the egg shell. In most cases the yolk sac had been drawn into the body cavity. A large number of embryos dying at this stage would have indicated an incubator problem.

Pip: These embryos, whether dead or alive, had pipped the egg shell but had not broken free of the egg. A large number of embryos dying as pips would also likely indicate an incubation problem at the hatchery.

Addled: Addled eggs had no visible embryos but the yolks and albumen were so mixed up that it was impossible to determine if the egg was infertile or contained an embryo that died at a very early stage of development.

Cracked: Any cracked eggs found during candling were noted. If a cracked egg was clear or had a blood

ring, it was broken open to classify it as infertile or an early dead. If the embryo in the egg was still living, the egg was left in the tray and broken open if it did not hatch. Eggs cracked after candling were not recorded.

Rotten: Rotten eggs would have a dark yolk or albumen. They often contained lumpy pieces of yolk or had a foul odour. When possible, the fertility or age of dead embryos in these eggs was also noted.

Upside Down: Eggs that were found during candling with their air cells pointing down were classified as upside down. The fertility or age of embryonic death of any embryos was recorded.

Fertility: The fertility was the percentage of the eggs set that either hatched, contained dead embryos or were addled.

Hatchability: The hatchability was the percentage of chicks hatching out of the eggs set and included both saleable and cull chicks.

Spread: The spread was the difference between the percentage fertility and hatchability. For example, if eggs with 95% fertility had 85% hatchability, the spread would be 10% points. The spread is an indicator of how well the fertile eggs hatch.

Statistics

All of the results were grouped according to the age of the breeder flock at the time that the eggs were layed. The age groupings were 30.0-34.9, 35.0-39.9, 40.0-44.9, 45.0-49.9, 50.0-54.9, and 55.0-59.9 weeks of age. A few eggs were monitored for flocks either younger than 30 weeks or older than 60 weeks of age but these results are not reported because of the small number of flocks examined.

The egg shell thickness data was analyzed separately for each age grouping. An analysis of variance in which shell thickness and hatchery were fixed effects was used. Since no significant hatchery effects were observed, only the combined results for the whole province will be reported. The test of whether dipping eggs in salt solutions to measure specific gravity would affect hatchability was analyzed by a paired T-test.

Results

Hatchability Monitoring

Figures 1 and 2 compare the hatching egg performance in Saskatchewan to that found by a recent survey in Georgia, U.S.A. (Mauldin, 1989). Some caution must be used when comparing the age of embryonic death in Saskatchewan to that in Georgia since the age of embryonic death was classified a bit differently in the Georgia study. General conclusions, however, can be made about the differences between Saskatchewan and Georgia:

- Low fertility after the breeder flocks in Saskatchewan reached 40 weeks of age reduced average hatchability in the province by 2.75% compared to Georgia. Separate male feeding and improved cockerel rearing are now being promoted in Saskatchewan as methods of improving the fertility.

- High early embryonic mortality (Day 1-7) cost Saskatchewan 2% in hatchability compared to Georgia. High early embryonic mortality is associated with egg storage conditions, thin egg shells and low feed intakes (McDaniel *et al.*, 1979; Pearson and Herron, 1982; Hodgetts, 1988).
- The Day 8-14 embryonic deaths were similar to those in Georgia. Research has indicated that nutritional deficiencies will cause a peak in embryonic mortality at this age (Leeson *et al.*, 1979). Compared to Georgia, the birds in Saskatchewan do not appear to be suffering from any obvious nutritional problems. Indeed, bacterial contamination and not nutrition appeared to be the problem with the Day 8-14 embryonic deaths.

- The Day 15-21 deaths were similar in Saskatchewan and Georgia. Since large numbers of embryos dying at this age would have implicated a problem with hatchery practices, it would appear that Saskatchewan hatcheries are doing a good job of managing their incubators and hatchers.

These findings help to direct future efforts to improve hatchability in Saskatchewan.

Figure 1
Fertility and Hatchability in Saskatchewan and Georgia

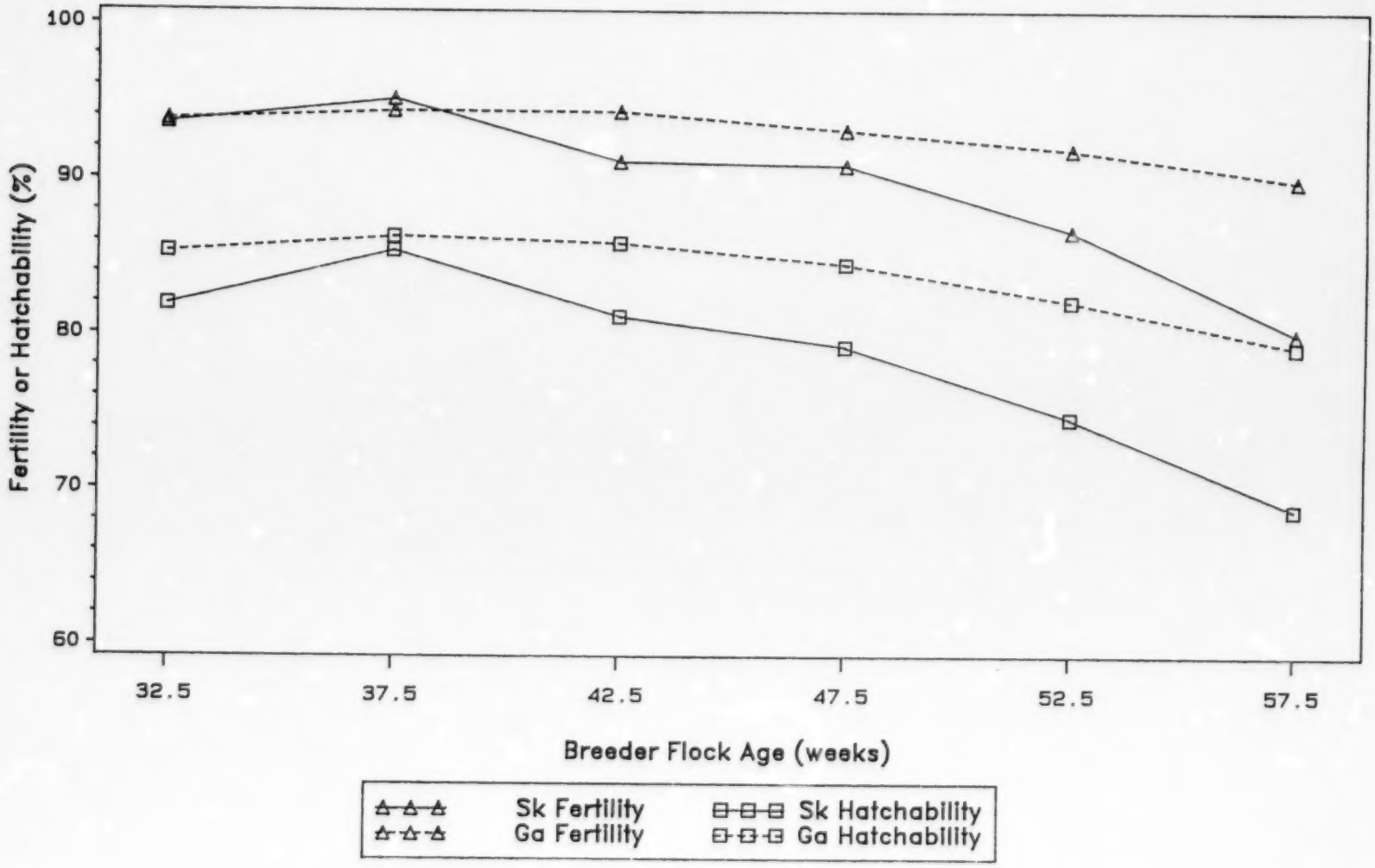
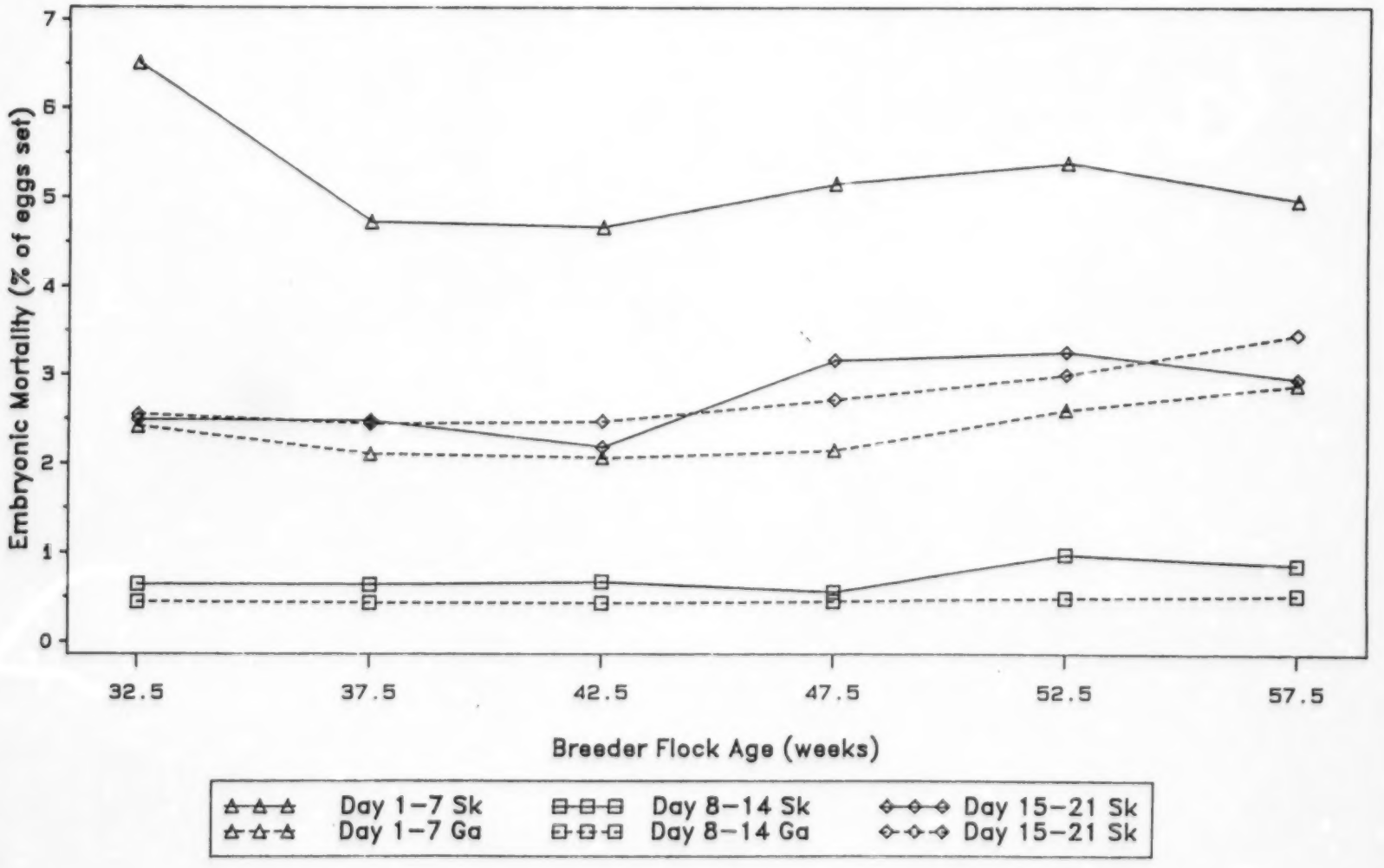


Figure 2
Embryonic Mortality in Saskatchewan and Georgia



Egg Shell Thickness

Survey of Specific Gravity: Are Our Egg Shells Too Thin ?

It is recommended that breeder flocks maintain an average specific gravity over 1.080 (Mauldin, 1987). In Figure 3, the specific gravities measured for 25 Saskatchewan flocks are shown along with the average line for shell thickness in the province. Shell thickness in Saskatchewan appeared to be low because the specific gravity of the eggs dropped to less than 1.080 before the flocks were even half way through their production cycle. Many flocks had 90% of their eggs being thin shelled by the time that they ended egg production.

Floating Eggs in Salt Solution: Does It Affect Hatchability ?

In Table 1, the effect of floating eggs in salt solutions to determine their specific gravity is shown. The Day 1-3 embryonic mortality was significantly reduced by 1.2% when the eggs were floated in salt solutions. The other indicators of early embryonic mortality, Day 1-2 and Day 1-7 mortality, were unaffected by measuring specific gravity. The Day 8-14 embryonic mortality was significantly increased by 0.8%; since most of the Day 8-14 dead embryos appeared contaminated, it may be that floating eggs in salt solutions increased the number of bacteria penetrating the egg shells. Overall, hatchability of eggs floated and not floated in the salt solutions was the same. The spread was also the same, indicating that the hatchability of fertile eggs was unaffected by measuring specific gravity. For the most part, it appears that using salt solutions to measure shell thickness does not adversely affect the hatchability of eggs.

Hatchability of Thick and Thin Shelled Egg in Saskatchewan

As can be seen in Table 2, the hatchability of thick shelled eggs was superior to that of thin shelled eggs. The major trends noticed in this study were:

- The early embryonic mortality, Day 1-7, was 1.0% higher for almost every age of breeder flock. Because high early embryonic mortality is a sign of poor egg storage conditions, it appears that thin shelled eggs do not store as well as thick shelled eggs. The thin shelled eggs may not store as well because thin shelled eggs lose moisture more readily (McDaniel *et al.*, 1979). Other researchers have also shown increased numbers of embryos dying at early ages in thin shelled eggs (McDaniel *et al.*, 1979; McDaniel *et al.*, 1981).

- The Day 8-14 embryonic mortality was 0.5% higher for thin shelled eggs for almost every age of breeder flock. Since most of the Day 8-14 dead embryos appeared to be contaminated by bacteria, it is likely that the thin shells were more easily penetrated by bacteria. Increased contamination of thin shelled eggs has been noted previously (Anonymous).

- The Day 15-21 embryonic mortality was 0.5% higher for the thick shelled eggs before 40 weeks of age and 1.0% lower afterwards. Before 40 weeks of age, the thick shells may have had increased mortality because water loss from the eggs was reduced or the chicks had trouble breaking the shells. After 40 weeks of age, the thin shelled eggs may have had increased mortality because of excess moisture loss or increased bacterial penetration. Research on commercial breeder flocks in the United States has shown increased Day 15-21 embryonic deaths in both young and old breeder flocks (McDaniel *et al.*, 1981).

- The fertility of the thin shelled eggs was 1% - 5% lower for most ages of breeder flocks. It has been speculated that thin shelled eggs are less fertile because they are layed by overweight hens (McDaniel *et al.*, 1981).

- Because of the higher embryonic mortality and bacterial contamination, the thin shelled eggs had a 2% - 4% greater spread between fertility and hatchability for every age of breeder flock.

- Lower fertility and higher embryonic mortality caused the thin shelled eggs to have 3% - 9% lower hatchability with almost every age of breeder flock. If the specific gravity in Saskatchewan flocks could be kept at or above 1.080, the improved fertility and decreased embryonic mortality would increase the average hatchability in the province by approximately 1.0%.

The statistical significance associated with these trends can be seen in Table 3.

FIGURE 3.

SHELL THICKNESS IN SASKATCHEWAN

(SPECIFIC GRAVITY)

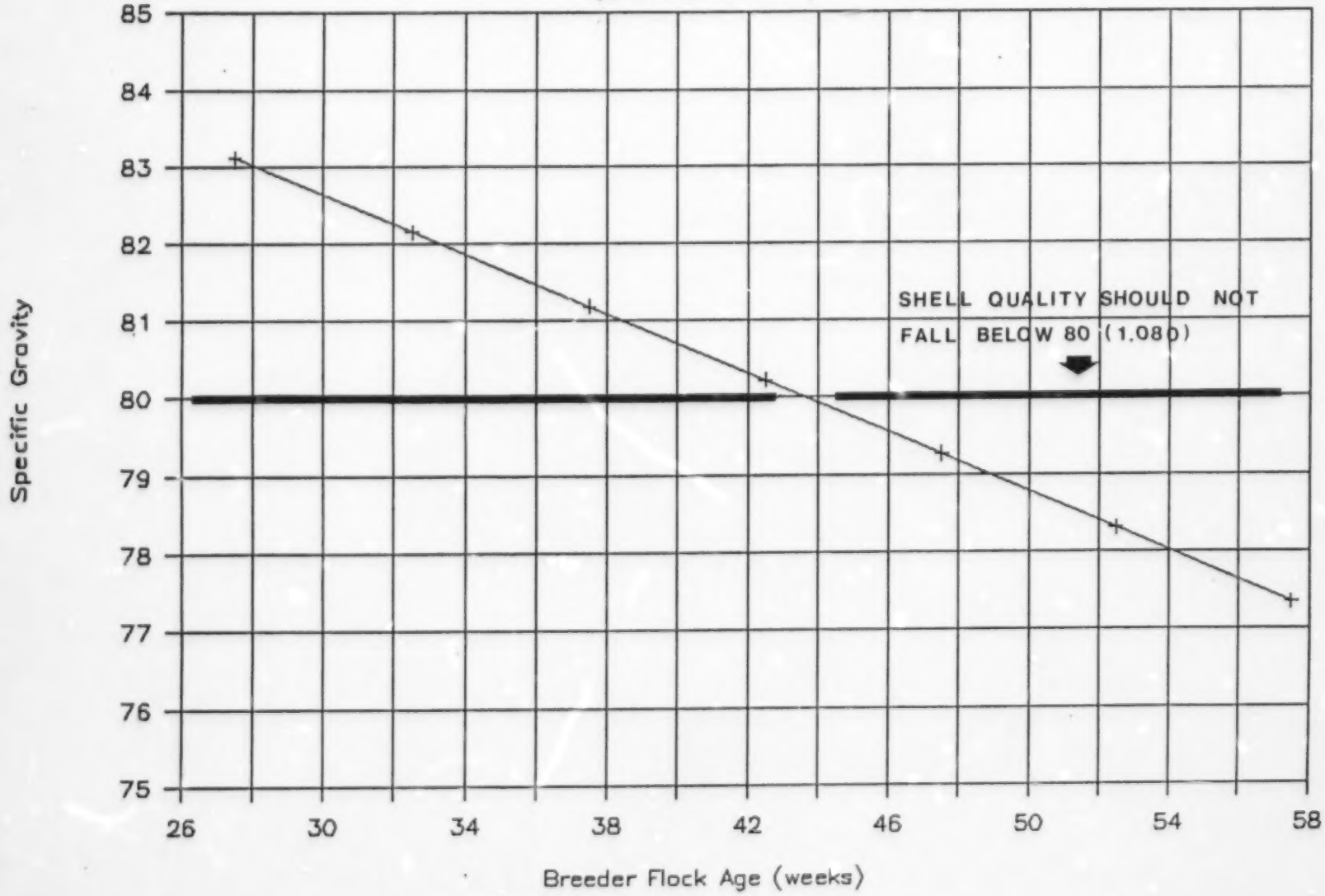


TABLE 1. *Effect of measuring specific gravity on embryonic mortality, fertility, hatchability and spread (x ± SEM)*

	Percent of Total Eggs Set								
	Day[1] 1 - 2	Day 1 - 3	Day 1 - 7	Day 8 - 14	Day 15 - 21	Pip	Fertile	Hatch	Spread
Specific Gravity Not Measured	1.3	4.7[a]	5.8	0.8	4.3	1.0	88.1	75.5	12.6
Specific Gravity Measured	0.9	3.5[b]	5.1	1.3	3.5	1.3	87.7	75.7	12.0

[a,b] Means within a column with no common superscripts are significantly different ($P<0.05$).

[1] Day 1 -2 embryonic mortality only includes embryo's identified during candling at 6 days incubation.

Table 2. *Effect of shell thickness on embryonic mortality, fertility, hatchability and spread (x ± SEM)*

		Age of Breeder Flock						
Treatment[1]		30.0 - 34.9	35.0 - 39.9	40.0 - 44.9	45.0 - 49.9	50.0 - 54.9	55.0 - 55.9	Overall
Number of Flocks		7	7	6	6	4	13	
Average Specific Gravity		82.2	80.2	80.5	78.9	78.1	77.6	79.7
Incidence of Thin Eggs, % of eggs set		51.3	66.1	68.9	71.0	82.3	88.4	70.5
Day 1 - 2,[2]	Thick	0.7	1.0	0.7	0.8	0.0	0.0[a]	0.5
% of eggs set	Thin	1.4	0.6	1.4	0.9	0.5	1.5[b]	1.2
Day 1 - 3,	Thick	3.6	3.5	1.3[a]	2.9	2.1	3.9	3.1
% of eggs set	Thin	5.3	3.8	3.4[b]	3.5	4.0	3.6	4.0
Day 1 - 7,	Thick	5.3	5.2	3.1	3.9	4.2	4.6	4.4
% of eggs set	Thin	7.2	5.4	4.5	4.7	5.4	5.4	5.7
Day 8 - 14,	Thick	0.6	0.3[a]	0.8	1.3	0.0[a]	0.4	0.6
% of eggs set	Thin	1.0	0.9[b]	1.3	0.4	1.6[b]	0.8	0.9
Day 15 - 21,	Thick	3.1	3.1	1.2[a]	2.2	1.8	1.1[a]	2.0
% of eggs set	Thin	2.3	2.6	3.0[b]	2.4	3.3	2.9[b]	2.7
Pip,	Thick	0.8	1.0	1.1	0.5	1.9	1.2	1.1
% of eggs set	Thin	0.9	1.0	1.3	1.0	0.9	0.9	0.9
Fertility,	Thick	94.9	95.7	92.6	92.5	80.9[a]	83.3[a]	90.0
% of eggs set	Thin	91.5	94.7	93.0	87.7	86.3[b]	77.9[b]	87.4
Hatchability,	Thick	84.0[a]	86.2	85.8[a]	84.1[a]	69.8	75.3[a]	81.1
% of eggs set	Thin	78.4[b]	83.3	82.61[b]	77.2[b]	72.6	65.8[b]	75.7
Spread	Thick	10.9	9.9	6.8	8.4	11.1	8.0[a]	8.9
	Thin	13.1	12.8	10.4	10.6	13.7	12.1[b]	11.9

[a,b] Means within a column with no common superscripts are significantly different ($P<0.05$).
[1] Thick = Eggs with specific gravity greater than 1.080; Thin = Eggs with specific gravity less than or equal to 1.080.
[2] Day 1 - 2 embryonic mortality only includes embryo's identified during candling at 6 days of incubation.
[2] No statistical analysis was done of the overall averages.

TABLE 3. *Progressive effect of shell quality on embronic mortality, fertility, hatch and spread at 55.0 to 59.9 weeks of age (x ± SEM)*

	Percent of Total Eggs Set								
Treatment[1]	Day 1 - 2	Day 1 - 3	Day 1 - 7	Day 8 - 14	Day 15 - 21	Pip	Fertility	Hatch	Spread
Thick Shells	0.0[a]	4.7	6.0	0.7	1.2	1.2	86.5	77.1	9.4
Thin Shells	0.6[a]	2.6	4.5	0.8	3.0	0.9	81.7	69.9	11.7
Very Thin Shells	1.6[b]	3.7	5.5	0.8	3.2	0.8	77.4	64.6	12.8
Linear Trend	*						*	*	

[a,b] Means within a column with no common superscripts are significantly different ($P<0.05$).

[1] Thick Shells = Specific gravity of 1.085 or more; Thin Shells = Specific gravity of 1.080; Very Thin Shells = Specific Gravity of 1.075 or less

* Indicates a significant linear trend ($P<0.05$)

Although not shown in Table 3, the thin shelled eggs tended to have more cracked eggs (1.7% *versus* 1.2%), rotten eggs (1.2% *versus* 0.7%) and addled eggs (0.8% *versus* 0.4%) than the thick shelled eggs.

Hatchability of Thick, Thin and Very Thin Eggs

In Table 3, the hatchability results for thick, thin and very thin eggs from 55 - 59 week old breeder flocks are displayed. The progressive of effect of egg shell thickness on Day 1-2 embryonic mortality, fertility and hatchability was demonstrated. The thinner an egg shell became, the more adversely its hatchability was affected.

Reasons for the Low Egg Shell Quality

The feed given to broiler breeders in Saskatchewan varies from 2.8% to 3.3% calcium, with these levels being adequate to well over the requirements of the hens. Almost every flock in the province, however, developed a high percentage of thin shelled eggs. Low levels of calcium in the feed do not appear to be the cause of the thin shells.

Another likely possibility was that the eggs were very large, stretching out the limited amount of shell (Roland, 1978). To see if the eggs in Saskatchewan were very large, eggs from numerous flocks were weighed.

Egg Weight

In Figure 4, the eggs weights for Saskatchewan are shown along with the Arbor Acre breeder standard for egg weight; the Arbor Acre breed of pullet accounted for the majority of breeder flocks in the province. The egg weight in Saskatchewan flocks was slightly above the breeder standard in young flocks, perhaps because our flocks tend to come into production a little early. After about 30 weeks of age, however, our egg weight appears to be slightly below the breeder standard. The lower egg weight could be due to lower fat levels in Saskatchewan feed than in the corn based rations commonly fed in other parts of North America. It had been expected that the egg weight in Saskatchewan would be above the breeder standard because the eggs in this province have thin shells and large egg size is a common cause of thin shells.

Egg Weight Range

The egg weight range was measured for many Saskatchewan and Arkansas flocks which were shipping eggs to the two hatcheries in Saskatchewan. In Figure 5, the egg weight range is presented for flocks which had average egg weights falling into the following classifications: 55.0-59.9g, 60.0-64.9g and 65.0-69.9g. By grouping the eggs this way, the egg weight ranges of eggs of approximately the same average size could be compared for Saskatchewan and Arkansas flocks. The egg weight range appeared to be much larger in Saskatchewan than in Arkansas; the Saskatchewan flocks had more very large and very small eggs at the same average egg weight.

The most likely cause of the greater range in egg weight is that the pullets in Saskatchewan have more variable body weights than pullets in Arkansas. Indeed, one reason for measuring egg weight uniformity was to gain a crude but rapid method of quantifying pullet uniformity in the province. The relationship between body weight and egg weight is well documented (Harms *et al.*, 1982). In feed restricted birds like broiler breeders, body weight is often quite variable and will cause variability in egg size.

One of the consequences of large ranges in egg weight is that Saskatchewan eggs will have a greater percentage of extra large eggs and these eggs likely have very thin shells. The high percentage of thin shelled eggs occurring after flocks reach 45 weeks of age may be caused by poor egg weight uniformity. The egg weight uniformity might also explain the observation that eggs from Saskatchewan hatch slower than American eggs; since egg weight is related to hatching rate, a wide range in egg weights could cause a longer, more dragged out hatch.

Summary of Findings

- Low fertility after 40 weeks of age and high early embryonic mortality throughout production caused hatchability in Saskatchewan to be 4.75% lower than in other parts of North America.

- As indicated by the level of Day 8-14 and Day 15-21 embryonic deaths, no major problems due to improper feed formulation or hatchery incubation practices were observed.

FIGURE 4. Egg Weight vs Age of Flock

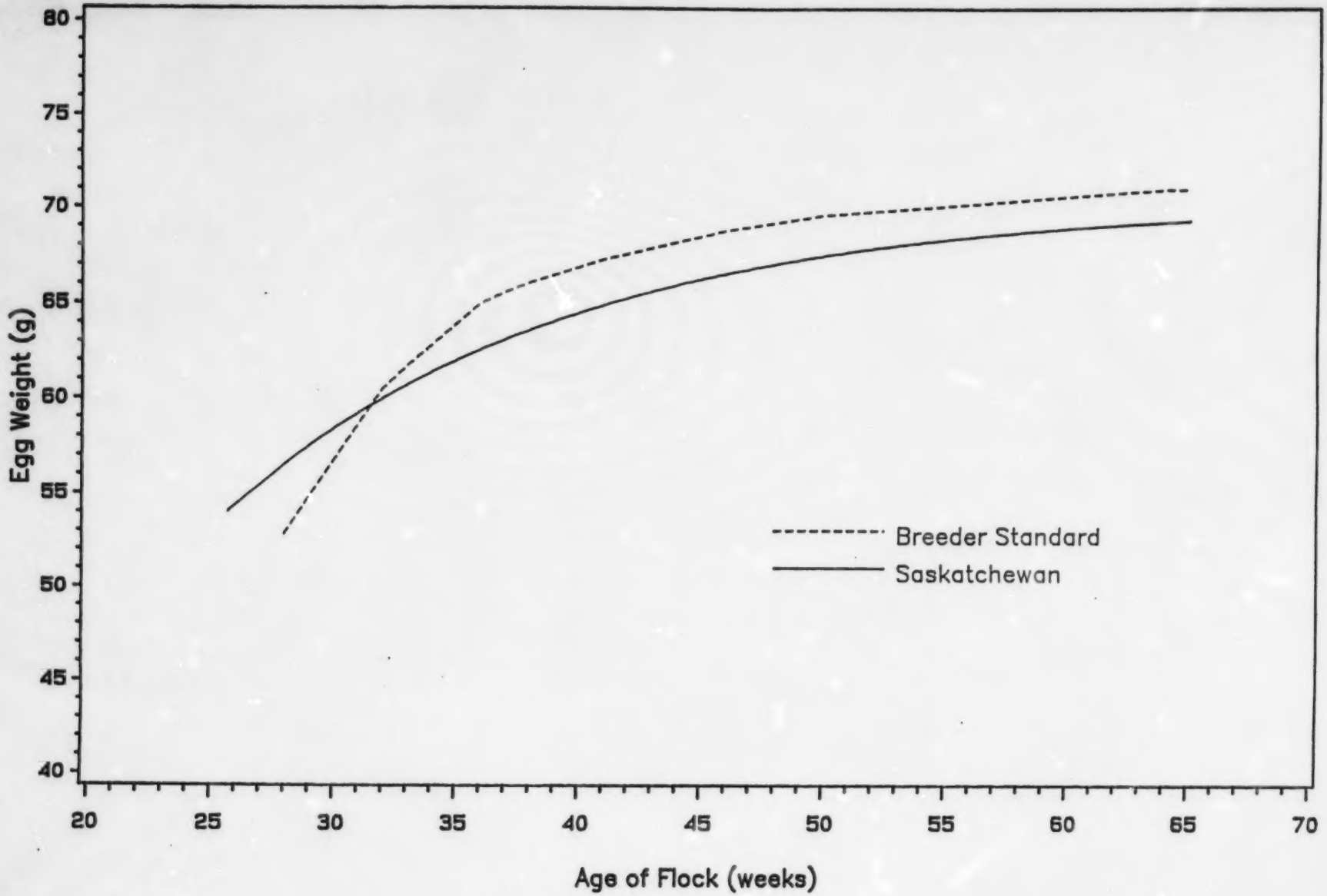


FIGURE 5.

Uniformity of Egg Size in Saskatchewan and the United States

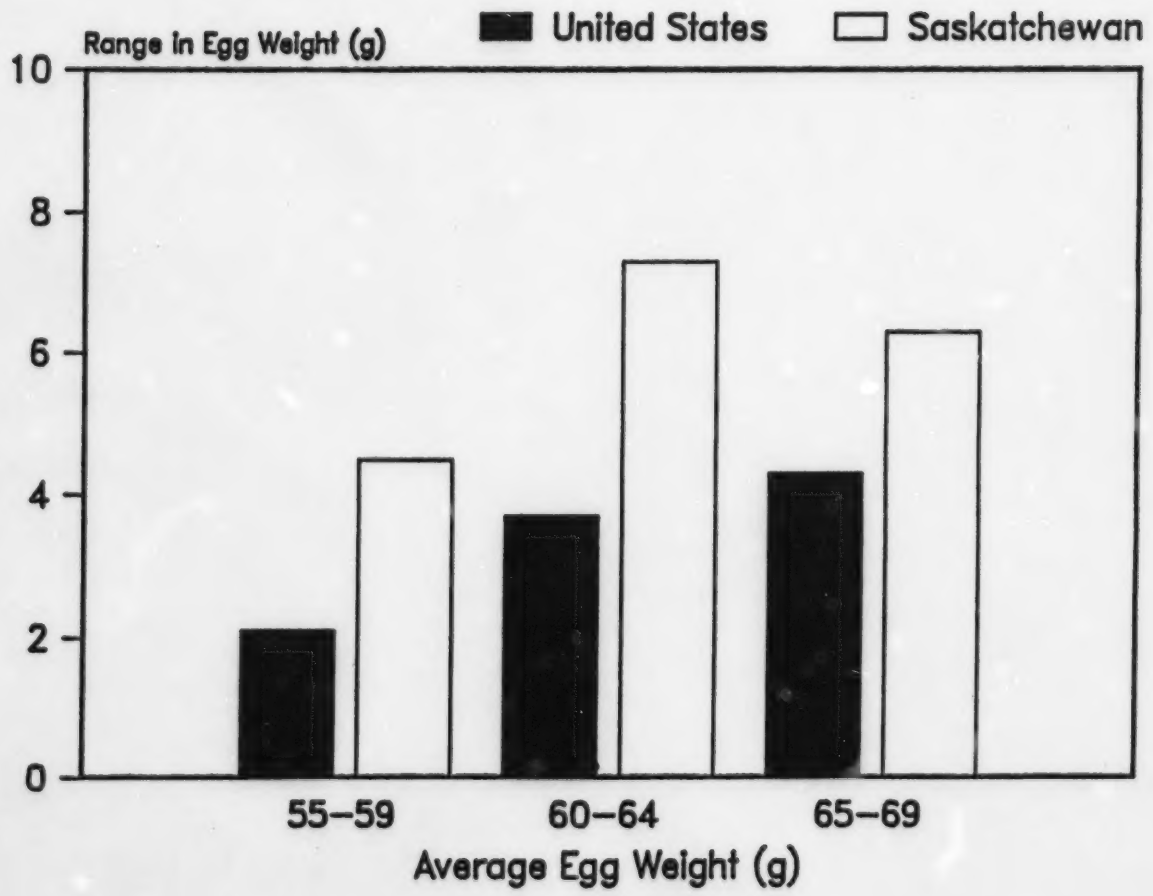
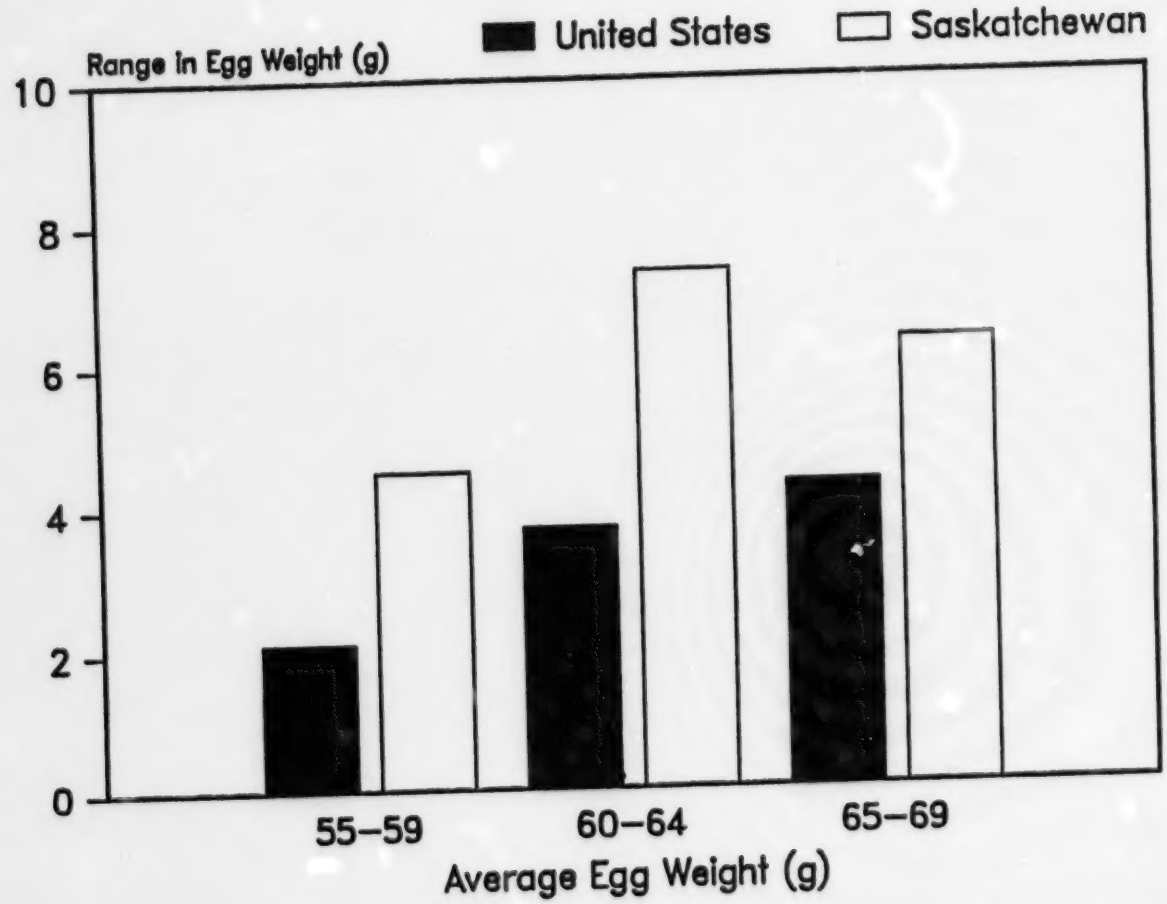


FIGURE 5.

Uniformity of Egg Size in Saskatchewan and the United States



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Appendix A

Egg Shell Thickness, Egg Weight and Fertility Monitoring Sheets

Farm _____ Flock _____ Date _____ Flock Age _____weeks

NUMBER OF EGGS IN EACH EGG WEIGHT GROUP

EGG WT (Grams)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
44-46																										45	# _____=_____
46-48																										47	# _____=_____
48-50																										49	# _____=_____
50-52																										51	# _____=_____
52-54																										53	# _____=_____
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74-76																										75	# _____=_____
76-78																										77	# _____=_____
																										TOTAL:	_____ _____

AVERAGE EGG WEIGHT _____

SPECIFIC GRAVITY MEASUREMENTS

NUMBER OF EGGS FLOATING IN EACH SOLUTION

Specific Gravity	75	80	85	90	Total
Number of Eggs					

Average Specific Gravity _____

% Thin Eggs (SG of 75 & 80) _____

% Very Thin Eggs (SG of 75) _____

FERTILITY

# of Fertile Eggs_____

# of Eggs Checked_____

Fertility_____

Appendix B

Article Submitted to Canada Poultryman

Thin Shelled Hatching Eggs: Are You Losing 1.0% in Hatchability?

Thin shelled eggs could be costing you 1.5% in hatchability. A study of the egg shell thickness of 8,000 eggs from 25 broiler breeder flocks has found that thin shelled eggs are causing significant losses in hatchability. This study by the University of Saskatchewan is the first of its kind in Canada and indicates that egg shell thickness is more of a problem than previously thought.

The egg shell thickness was determined by using the "specific gravity" method in which eggs are floated in salt solutions. Eggs with thick shells sink to the bottom of the salt solutions while the thin shelled eggs float. This method of measuring shell quality is easy, inexpensive and does not require that the eggs be broken open. The specific gravity method is the method most commonly used by researchers to measure shell thickness. It has also been promoted by the Ontario Commercial Egg Producers' Marketing Board as a method that producers can use on their own farms. Specific gravity measurements are much more sensitive at detecting thin shelled eggs than inspecting the eggs by eye.

Breeder specialists such as Joseph Mauldin at the University of Georgia say that a breeder flock should be able to maintain a specific gravity of over 1.080 until the end of production. At this specific gravity, approximately 70% of the eggs would be thin shelled. As can be seen in the graph below, the average flock in the study had over 70% thin shelled eggs by 45 weeks of age. Indeed, most of these commercial breeder flocks had 90% thin shelled eggs by the end of egg production.

When the different types of shells were compared, the thin shelled eggs clearly had inferior hatchability:

	Thick Shells	Thin Shells
Percent of Eggs Set		
Early Dead Embryos	4.6	5.7
Middle Dead Embryos	0.6	0.9
Late Dead Embryos	2.0	2.7
Fertility	90.0	87.4
Hatchability	81.1	75.7

If the percentage of thin shelled eggs could be kept at or below 70%, the hatchability over the life of a flock would increase by approximately 1.0%.

The increased early deads in the thin shelled eggs indicate that they do not store as well as thick shelled eggs. The early deads are embryos dying in the early stages of incubation. Since thin shelled eggs lose moisture more rapidly during storage, it is important to make sure that the eggs are stored at 70% - 80% relative humidity. The early embryonic deaths were highest for the thin shelled eggs from young breeder flocks.

The thin egg shells were more easily penetrated by bacteria than the thick egg shells. Indeed, 1.2% of the thin shelled eggs were bacterially contaminated compared to only 0.7% of the thick shelled eggs. Because of bacterial contamination, clean nests are critical for flocks with thin shells.

The fertility of the thin shelled eggs was reduced by 2.6%. Since a hen forms the shell after the egg has been fertilized, however, the thin shell itself does not have a direct effect on the egg's fertility. The hens that lay thin shelled eggs are likely fat hens that are not as fertile and lay larger eggs than their slimmer sisters. Some of the reduction in hatchability of thin shelled eggs is related to the condition of the hens laying the eggs and not just the condition of the shell.

Reasons for the Low Egg Shell Thickness

The feed being given to the broiler breeders on the farms studied varied from 2.8% to 3.3% calcium, with these levels being adequate to well over the requirements of the hens. Almost every flock, however, developed a high percentage of thin shelled eggs. Low levels of calcium in the feed did not appear to be the cause of the thin shells.

More likely, the eggs were very large, stretching out the limited amount of shell. The keys to preventing a large percentage of your eggs from being extra large are to grow uniform pullets and to reduce feed after peak production. In this study, the problem appeared to be low pullet uniformity because of the unusually high percentages of very small and very large eggs. In feed restricted birds like broiler breeders, body weight is often quite variable and will cause variablity in egg size. The large, obese hens in a non-uniform flock will produce large, thin shelled eggs.

The results of this study indicate that egg shell thickness and pullet uniformity affect hatchability in commercial breeder flocks more than previously thought. While producers have sometimes worried that eggs might be too thick to hatch, the exact opposite appears to be true for many farms.

THIN SHELLED BROILER HATCHING EGGS